smart industry

IMPLEMENTATION AGENDA SMART INDUSTRY 2018 - 2021

SMART INDUSTRY 4.0 DUTCH INDUSTRY FIT FOR THE FUTURE

Prof Dr Ir Egbert-Jan Sol, Nov 2017, Program Director Smart Industry, TNO Industry / Radboud Uni. **www.smartindustry.nl**

Smart Industry is a initiative, started 2015, by:

FME POWERED BY DUTCH TECHNOLOGY

TNO innovation for life

kamer van koophandel

Ministerie van Economische Zaken en Klimaat

V N O N C W

dutch digital delta

Holland High Tech — Global Challenges. Smart Solutions — Holland.

Brabantse Ontwikkelings Maatschappij — BOM

LIOF

NOM INVESTEREN IN ONTWIKKELING

Innovation Quarter

oost nl

SMART INDUSTRY DUTCH INDUSTRY FIT FOR THE FUTURE

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SMART INDUSTRY DUTCH INDUSTRY FIT FOR THE FUTURE

Content

Introduction and main message

Technologies accelerates and we need to retrain everyone

But how is your business going to change?

## Implementing Smart Industry

Summary & Questions

SMART INDUSTRY DUTCH INDUSTRY FIT FOR THE FUTURE

Cornelis Corneliszoon van Uitgeest

Inventor (1593) enabling Holland's Golden Age (1600-1750)

Tekening bij het octrooi voor een door windkracht aangedreven houtzaagmolen dat de Staten van Holland aan Cornelis Corneliszoon van Uitgeest verleende op 15 december 1593
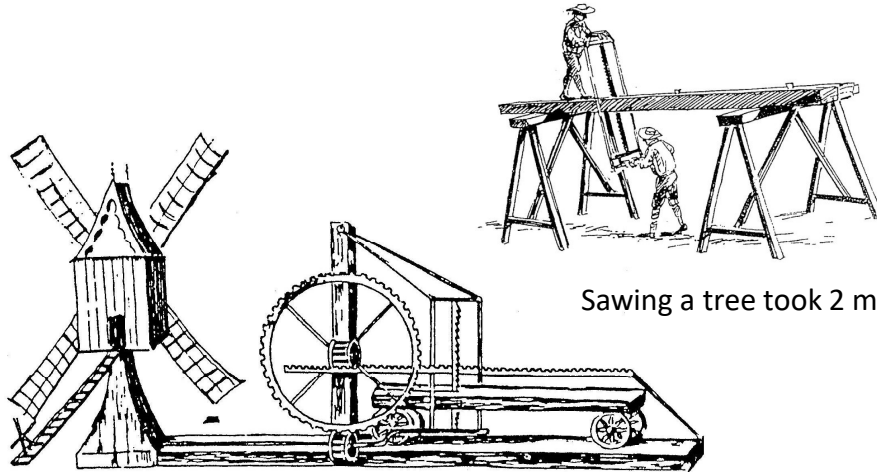
Sawing a tree took 2 men 30 weeks

SMART INDUSTRY DUTCH INDUSTRY FIT FOR THE FUTURE

Cornelis Corneliszoon van Uitgeest
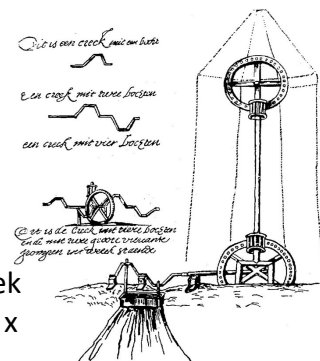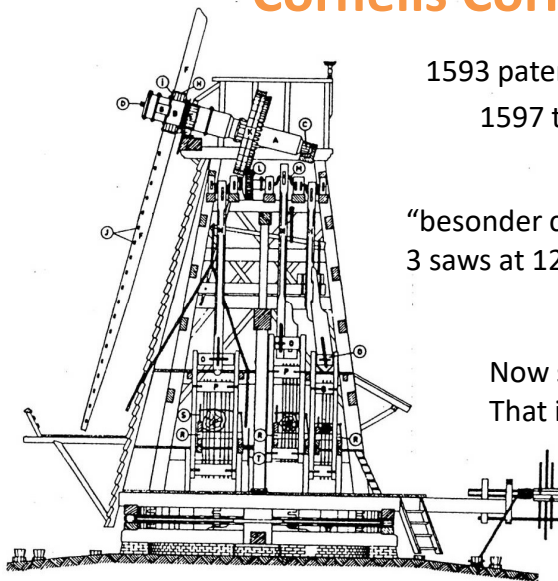
1593 patent sawing mill – did not work

1597 the improved crankshaft

"besonder creckwerk"
3 saws at 120º

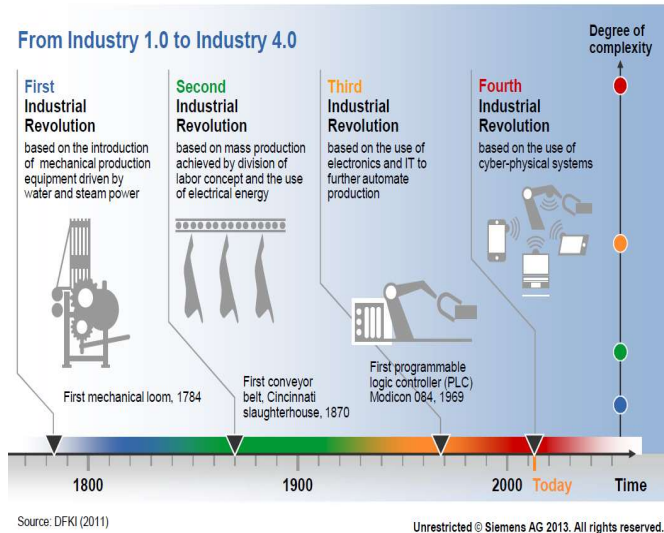Now sawing a tree took 1 week
That is an improvement of 30 x

By 1670 the Dutch had more then
5000 windmills and world largest fleet

SMART INDUSTRY DUTCH INDUSTRY FIT FOR THE FUTURE

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Industrial is changing faster

From Industry 1.0 to Industry 4.0

Source: DFKI (2011)

1600 Saw Mill
180 years, 6 generations

1780 Steam Engine
110 years, 4 generations

1890 Conveyor belt Mass prod.
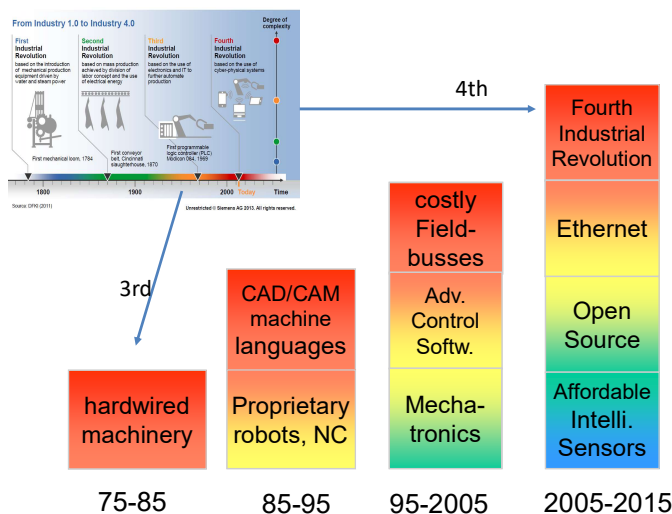**70 years,** 3 generations

1960 Mainframe, PLC, Robots
40 years, 1 generation

2000 Internet (of Things)
?? 25 years, < 1 generation

2025 Servitization/Sustainability
Agile/Metropolitan Manuf.

SMART INDUSTRY DUTCH INDUSTRY FIT FOR THE FUTURE

4th Industrial Revolution = Smart Industry: acceleration of digitalization in Industry

3rd

4th

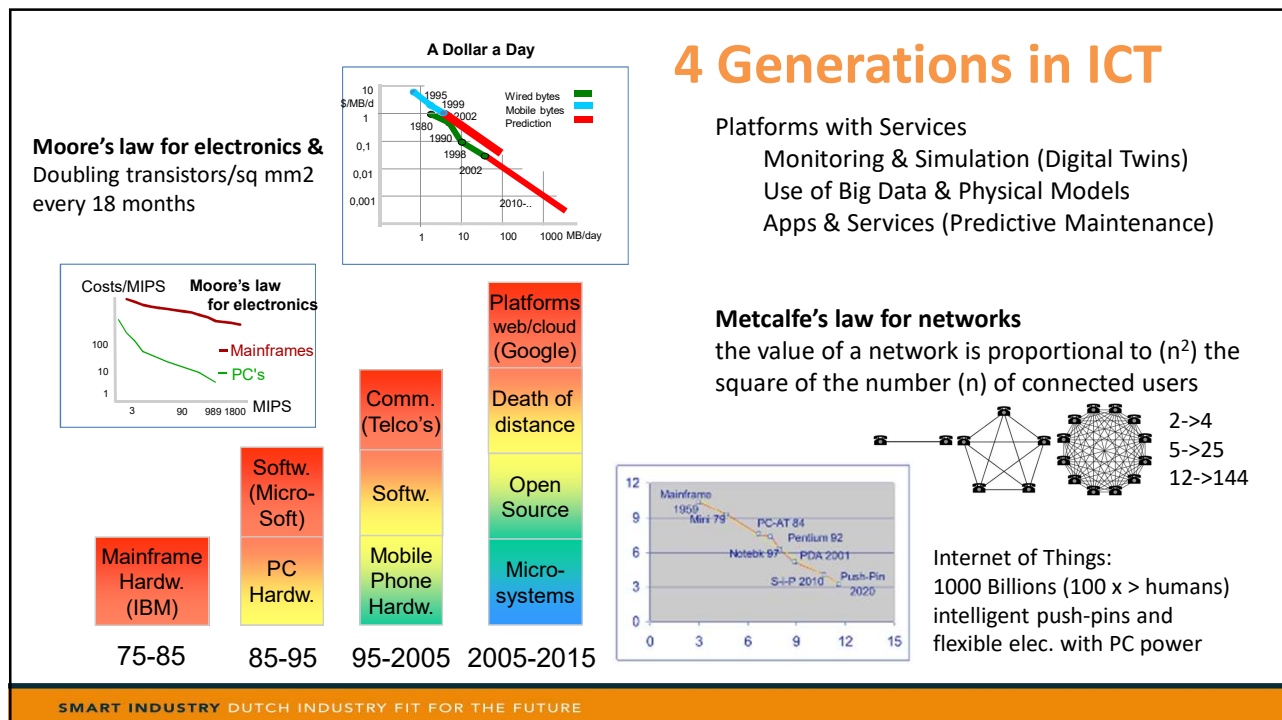| hardwired machinery	CAD/CAM machine languages	costly Field-busses	Fourth Industrial Revolution
	Proprietary robots, NC	Adv. Control Softw.	Ethernet
		Mecha-tronics	Open Source
			Affordable Intelli. Sensors
75-85	85-95	95-2005	2005-2015

Goal of the 4th indus. Rev. in Manufacturing:
of (Smart) Products

Lot size n=1 for the price of mass produced, produced (and recycled) in flexible, highly automated, zero-defect, smaller fabs , close to the customers:
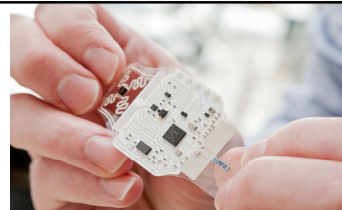Metropolitan or Agile Manufacturing

Goal of the 4th Indus. Rev. in Process Ind.:
 Improved performance by (smart) services by interconnecting many sensors, physical models and big data technologies for (smart) production and monitoring and maintenance

SMART INDUSTRY DUTCH INDUSTRY FIT FOR THE FUTURE

Slide 1

4 Generations in ICT

A Dollar a Day

Moore's law for electronics &
Doubling transistors/sq mm2 every 18 months

Platforms with Services
    Monitoring & Simulation (Digital Twins)
    Use of Big Data & Physical Models
    Apps & Services (Predictive Maintenance)

Costs/MIPS **Moore's law for electronics**

- Mainframes
- PC's

MIPS

Metcalfe's law for networks
the value of a network is proportional to (n^2) the square of the number (n) of connected users

2->4
5->25
12->144

Mainframe Hardw. (IBM)	Softw. (Micro-Soft)	Comm. (Telco's)	Platforms web/cloud (Google)
	PC Hardw.	Softw.	Death of distance
		Mobile Phone Hardw.	Open Source
			Micro-systems
75-85	85-95	95-2005	2005-2015

Internet of Things:
1000 Billions (100 x > humans) intelligent push-pins and flexible elec. with PC power

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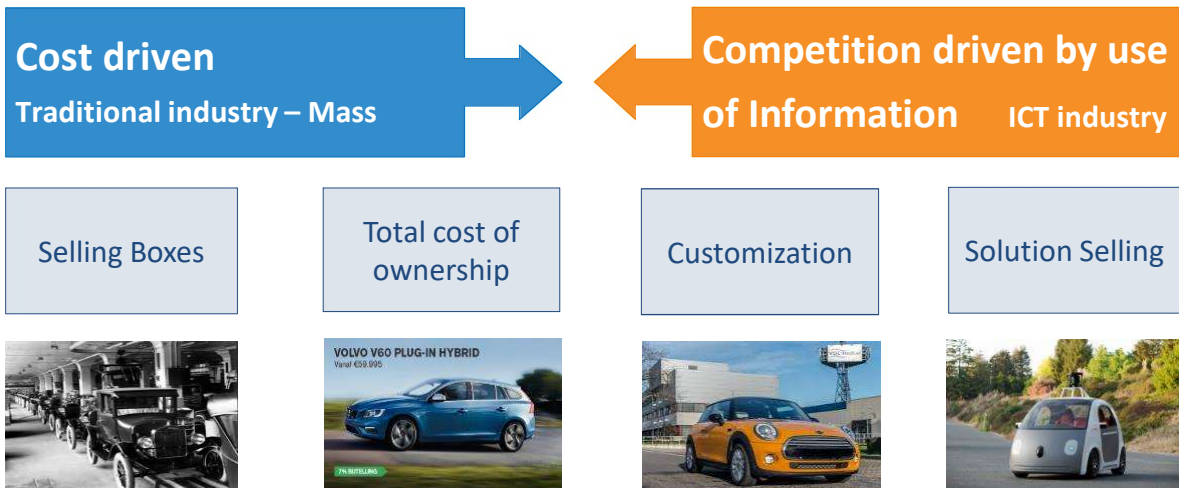
Slide 2

Services

- Electronics in products evolved into
  smart products with more and more services
  - services with a digitized piece of hardware (servitisation 4.0)
  - unique personalized products (personalisation 4.1)
- **Smart services – servitization with client/server platforms**
  - The evolution from OEM producer to solution provider
    - E.g. remote monitoring for conditioned based maintenance, car-sharing, …
  - The battle on platform dominance
    - Asset light platform companies – Uber/Airbnb is a taxi/hotel company without taxis/rooms, manufacturing uber?
- **Smart products – personalisation with distribution/devices**
  - Locally produced, used and refurbished/disassembled/recycled with metropolitan manufacturing
    - (Factory 4.0 / multi-feed stock & process intensification Chemistry 4.0)
 - Each unique product will have it's product life blockchain, starting with capital goods that are leased

SMART INDUSTRY DUTCH INDUSTRY FIT FOR THE FUTURE

Towards Smart Products and Services

Cost driven
Traditional industry – Mass

Competition driven by use of Information   ICT industry

| Selling Boxes | Total cost of ownership | Customization | Solution Selling |

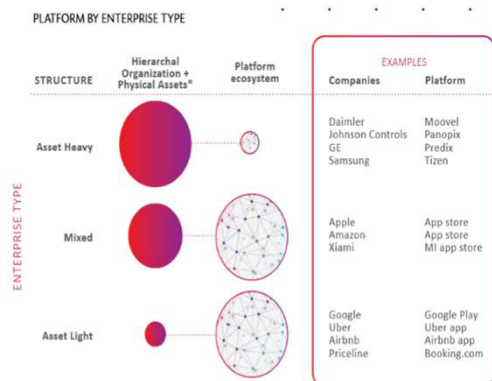SMART INDUSTRY DUTCH INDUSTRY FIT FOR THE FUTURE

Smart Products: Personalisation
Smart Services: Servitisation
=> Smart Industry
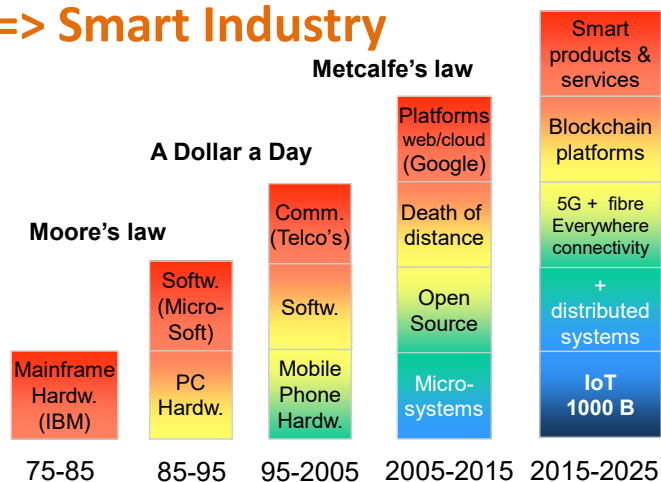
Personal Bank (bitcoin)
Personal Medicine/Food
Personalized Transport
Personal "Facebook'

Servitisation with asset light companies

Metcalfe's law

A Dollar a Day

Moore's law

| Mainframe Hardw. (IBM) | Softw. (Micro-Soft) / PC Hardw. | Comm. (Telco's) / Softw. / Mobile Phone Hardw. | Platforms web/cloud (Google) / Death of distance / Open Source / Micro-systems | Smart products & services / Blockchain platforms / 5G + fibre Everywhere connectivity / + distributed systems / IoT 1000 B |
| 75-85 | 85-95 | 95-2005 | 2005-2015 | 2015-2025 |

SMART INDUSTRY DUTCH INDUSTRY FIT FOR THE FUTURE

Never every in mankind:
Everyone's job changes completely within working life

Industrie 4.0 of Smart Industry (in Netherlands): acceleration of digitalization of industry

but we also see Smart Health, Smart Mobility, Smart Finance (FinTech), Smart Grid

Smart Society: all jobs will face digitalization

SMART INDUSTRY DUTCH INDUSTRY FIT FOR THE FUTURE

Everyone's job changes completely within working life and we can't afford to lose skilled people

35 years and above did not got Internet before 1997 at high school when they were 15+

35 year today implies retirement at 70 year, still 35 working years to go

How will we (re-)train every one between 35-60 year for?

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Tomorrow we face an empty human resource pool

2008   2016
61 y   65 y Reti.

21 y

8M = 8000K jobs, 40 cohorts of 1 year ■ of 200k people

2008-2016   200k/y   ➡   ▯ 200k/y

▯ 100k/y

800k top
Unemployment pool from crisis + postponed retirement

8M, but now less young people and more baby-boom retirem.

150k/y   ➡   ▮ 250k/y

2016-2022   0k/y
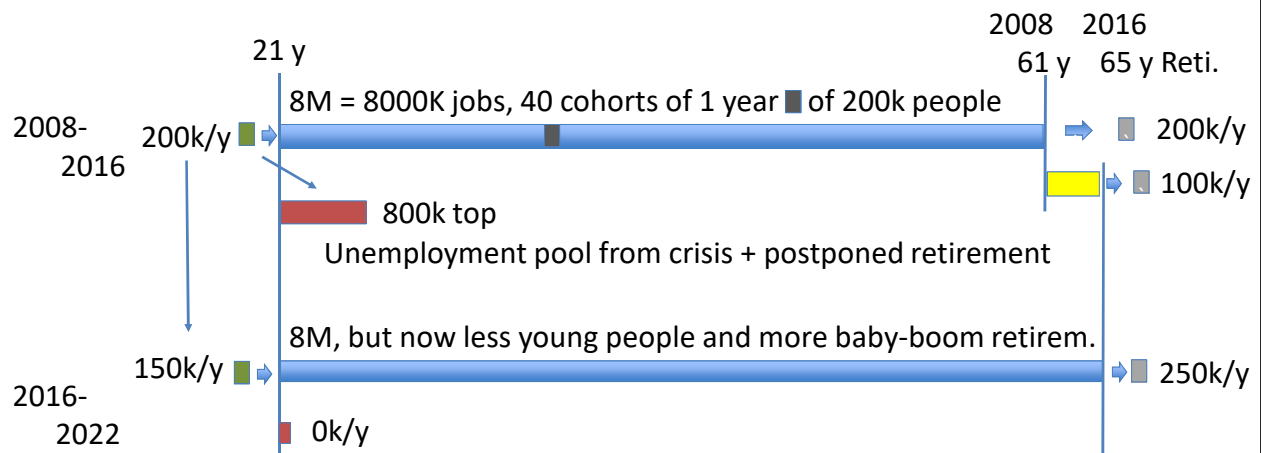
Economic tension by 2022: 400K unfilled jobs while digitalization accelerates
"You can't afford to loose any 35+ technical schooled employee"

SMART INDUSTRY DUTCH INDUSTRY FIT FOR THE FUTURE

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Technologies accelerates and we need to retrain everybody

But how is your business going to change?

- product evolution and innovation – driven by tech & econ.

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SMART INDUSTRY DUTCH INDUSTRY FIT FOR THE FUTURE

Costs, price=result+profit, efficiency, effectiveness, productivity, performance

Costs
norm (minimal)

75 → Norm Productivity

Result
norm (max.)

200 →

$$\text{Efficiency} = \frac{Cn}{Cr}$$

75%

Performance = Effic. x Effect

= (0,75 * 0,75) = 56%

$$\text{Effectness} = \frac{Rr}{Rn}$$

75%

Costs real

100 → Your System

150 →

Result real

$$\text{Productivity} = \frac{Rr}{Cr}$$
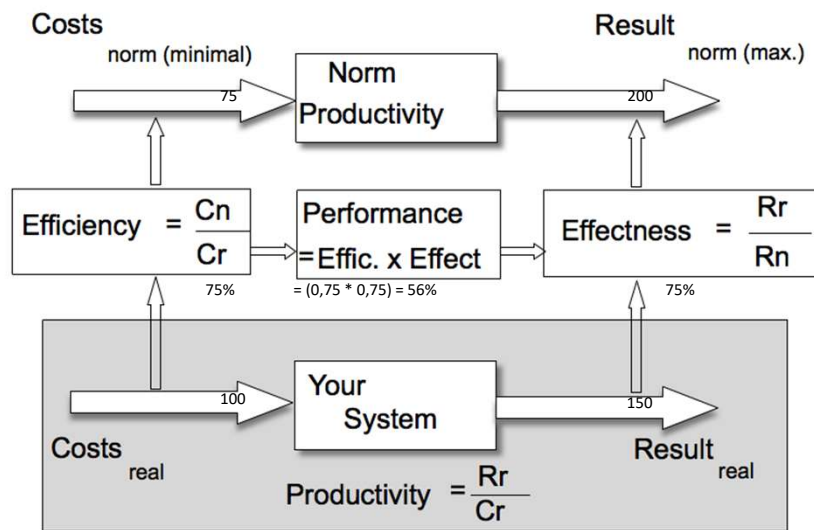
© Egbert-Jan Sol

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Value Creation: Added value = Price - Cost

Price

Added Value

Cost

Transport costs
Assembly costs

Price component 4

Price component 3

Price component 2

Price component 1

today

Service
Delivery
Costs

Hardware

tomorrow ?
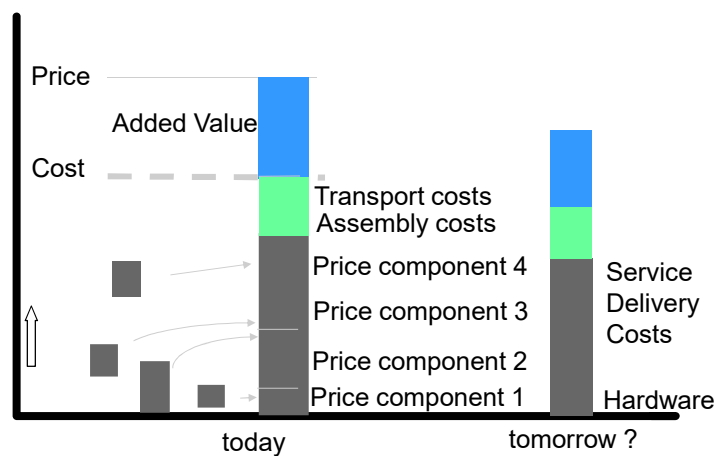
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But the added values shrinks over time

Price$_{yesterday}$

Added Value (yesterday)

Cost$_{today}$

? Price$_{tomorrow}$

Cost$_{tomorrow}$

Added Value

yesterday today tomorrow ?
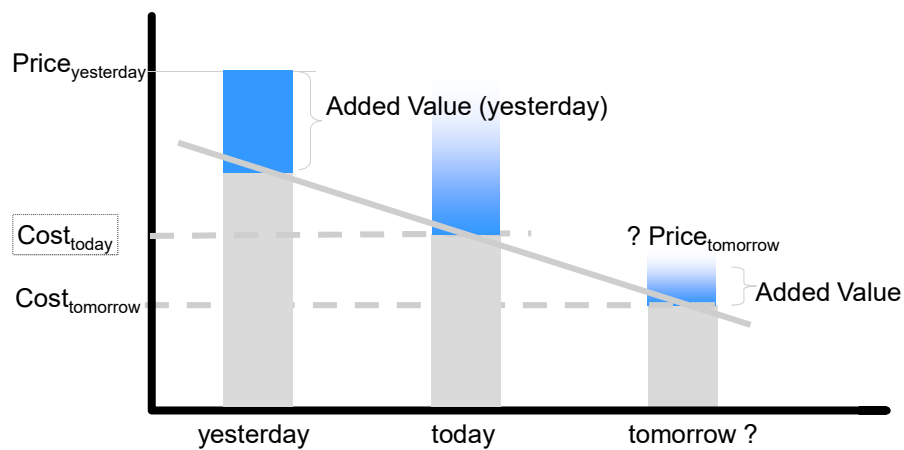
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What do we know on the price (? market) versus costs (learning curve)

Price$_{yesterday}$

Added Value (yesterday)

Cost$_{today}$

? Price$_{tomorrow}$

Cost$_{tomorrow}$

Added Value

yesterday today tomorrow ?
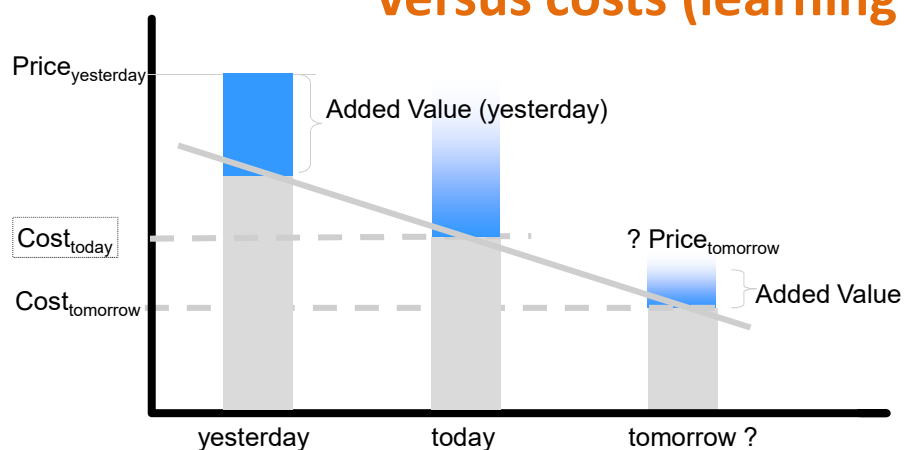
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Product Life Cycles – the Substitution Process

Examples of technologies:
CPU's (4004, 8080, 80286, i5, ..)
hard disks (8", 5MB ….. 2.5" 1TB)
mainframe, mini, micro computers
TV CRT, LED screens, OLED
telephony (speech), internet (information), blockchain (value)
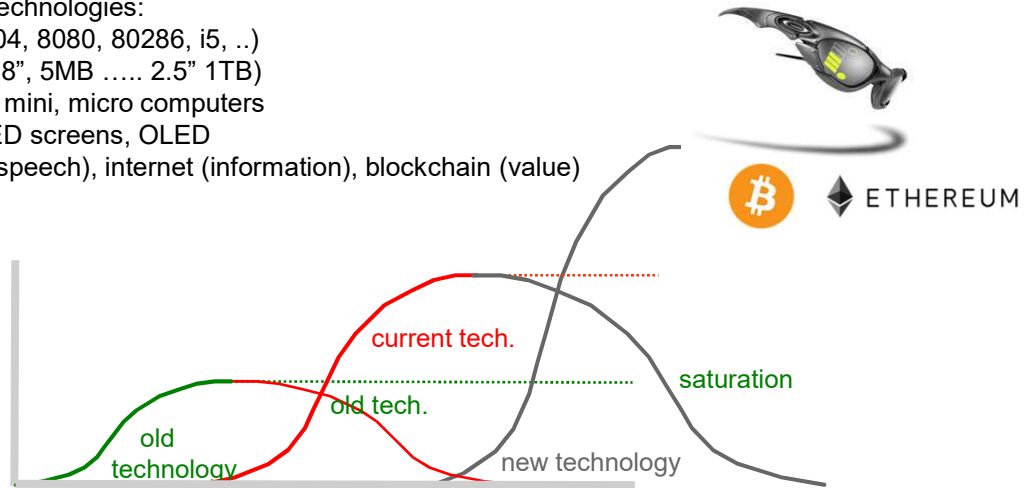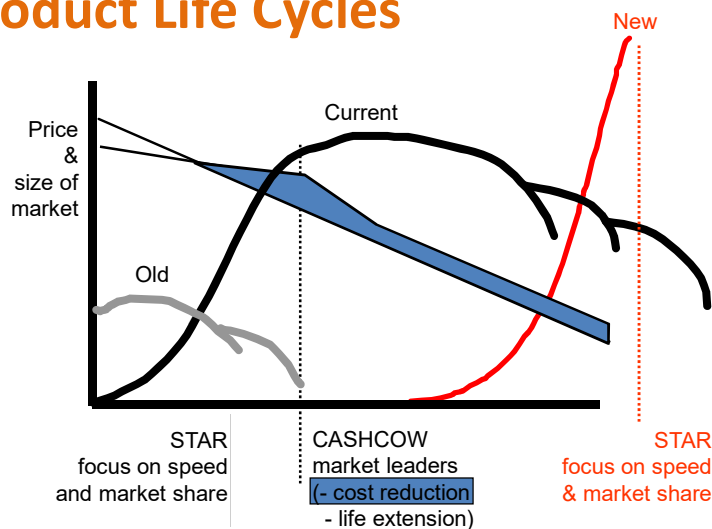
current tech.

saturation

old tech.

old
technology

new technology

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Product Life Cycles

New

Current

Price
&
size of
market

Old

STAR
focus on speed
and market share

CASHCOW
market leaders
(- cost reduction
- life extension)

STAR
focus on speed
& market share

SMART INDUSTRY DUTCH INDUSTRY FIT FOR THE FUTURE

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Introduction and main message

Technologies accelerates and we need to retrain everybody

But how is your business going to change?

- product evolution and innovate your product/services

- challenges, next to innovating your product

Implementing Smart Industry

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SMART INDUSTRY DUTCH INDUSTRY FIT FOR THE FUTURE

Challenges

Agriculture age 1800:
Till 1800 from 10M to 1B humans (100 x)
from hunting and fishing to agriculture

Industrial age: how wrong Marx was
Since 1800 making & transportation
of goods improved (100 x)

2000 and beyond: resource challenge
From 1B to 5B middle class consumers
we can't continue to plundering the earth
resources, burning fossil fuel and dumping
waste, we need to become sustainable

What can innovation offer?
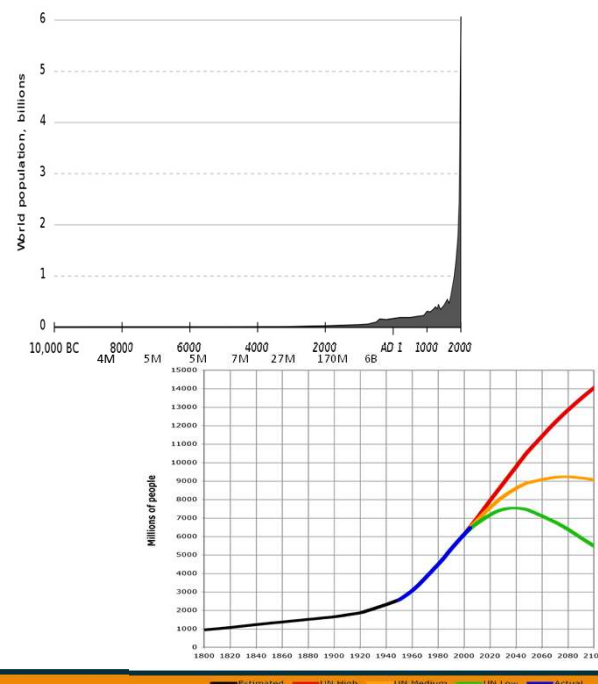
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Europe and the US have already depleted a significant part of their accessible resources

% of global mining
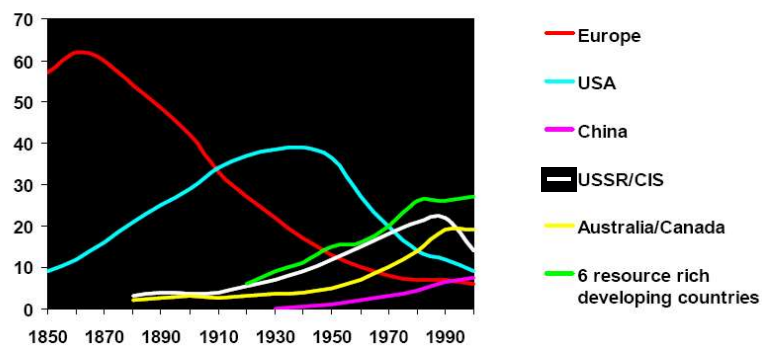
Sources: Raw Materials Data, Stockholm 2004, Sames, Raw Materials Group

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Mining is in the end an energy challenge too
## Mineralogical barrier for elements < 0.1% (mass) earth's crust

Extremely energy-intensive to extract

Remaining relevant resources of other minerals

"rare": Cu, Sn, Ni, Sb, Ag, ….

"trace": Pt, In, Se, Ga, ….
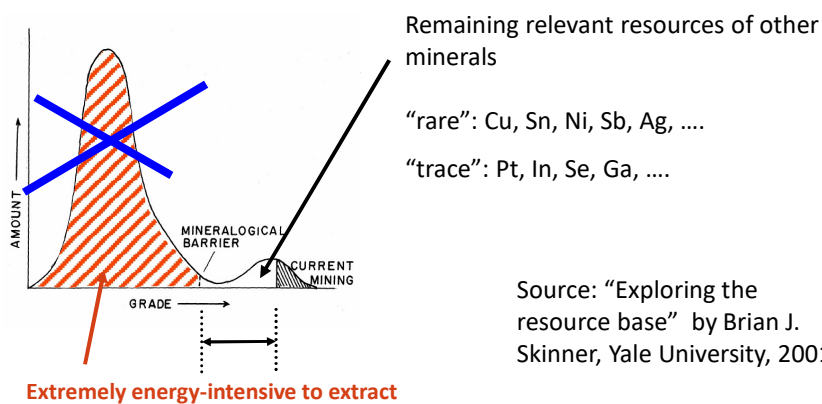
Source: "Exploring the resource base" by Brian J. Skinner, Yale University, 2001

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Passing through the bottleneck
What ever we can do & innovate now to reduces the future crisis

Denial, disbelief and blind optimism:
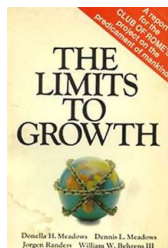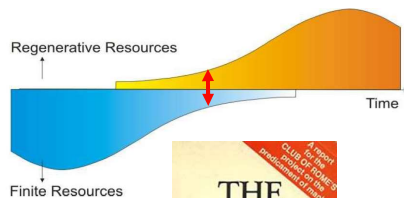
Proper and timely action:
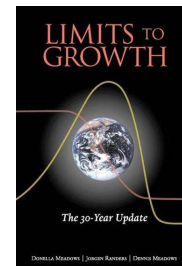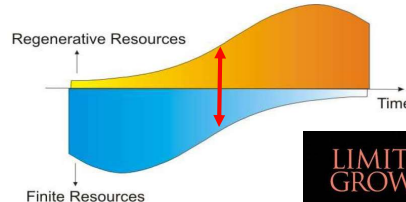
Armin Reller, 2009

SMART INDUSTRY DUTCH INDUSTRY FIT FOR THE FUTURE

Industrial Technologies: creating value at smaller scales

Trend **Manufacturing**: Meter sized metal constructions (pre 1950)
Value create at   Electronics tubes at millimetre precision
                Micro electronics
                    Nano lithography

Trend **Processes**: Meter sized vessels and refinery columns (400y)
Value create at   Process Intensification at mm scale Lab-on-Chips
                Micro droplet printing, or jetting
                    Nano manipulation at molecule level

Trend **Food** Preparation: Mixing in pots & pans to …
Value create at   controlling food & nutrients at millimetre level
Food structures made with (crude) 3D/Additive Manuf. printing

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Goals: Increase Productivity with Digitalization and Sustainability

Productivity improvement = ------------

Results $\Rightarrow$ Products & Services

Costs $\Rightarrow$ Production & Skills

**Results = innovative, new products with higher value**

More customized products, with faster delivery time,
for price of mass produced standard product from stock

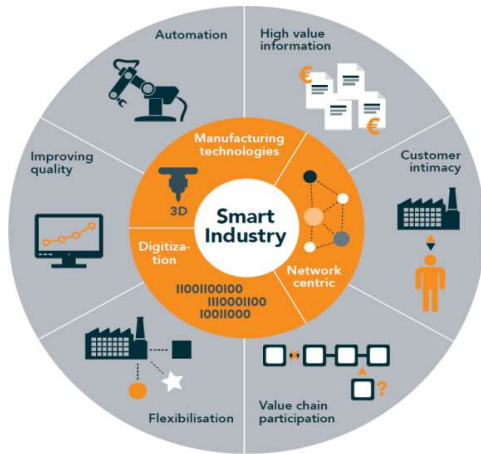**Costs = less (material) resources, less CO_2 consumption**

New constraint: cyber secure operations (if hacked, huge costs)

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Smart Products

Smart Servitization

Your chances with Smart Industry

Smart Production

Smart Skills
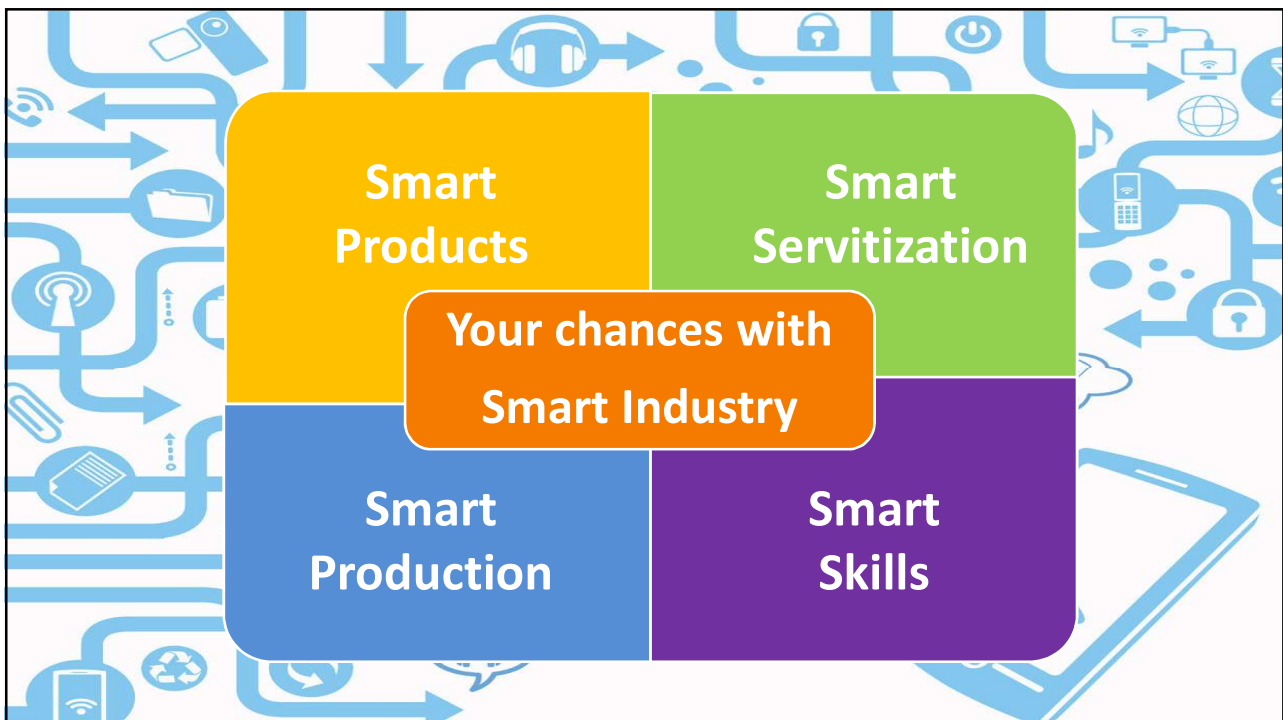
Smart Industry Action plan 2015 - 2017

Actionline 1: Awareness - Capitalising on existing knowledge

- Informing a wide target group, businesses, about the developments (industry 4.0)
- Entrepreneurs got to work

Actionline 2: Fieldlabs – accelerate developments by sharing to reduce risks

- Industrial enviroments where Smart Industry solutions are developed, tested, implemented as well as where people can learn to apply them

Actionline 3: Conditions – Strengthening the foundation

- Knowledge & Science roadmap
- Skills, life-long learning
- ICT, software tools, cyber security, trusted/shared data and standards

SMART INDUSTRY DUTCH INDUSTRY FIT FOR THE FUTURE

Smart Industry Fieldlab

Smart Industry: the acceleration of digitalization of industry

Fieldlab: *An industrial environment where Smart Industry solutions are developed, tested, implemented as well as where people can learn to apply them.*
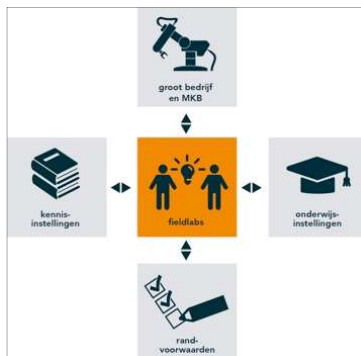
Criteria for a Smart Industry fieldlab
- Innovation eco-system
- Regional focus
- Radical innovations
- Interconnect higher & vocational education
- Training Human Capital
- Identification and application of new rules & standards
- Location with a program manager
- Program with 3+ year plan and multiple projects on
    innovation and education

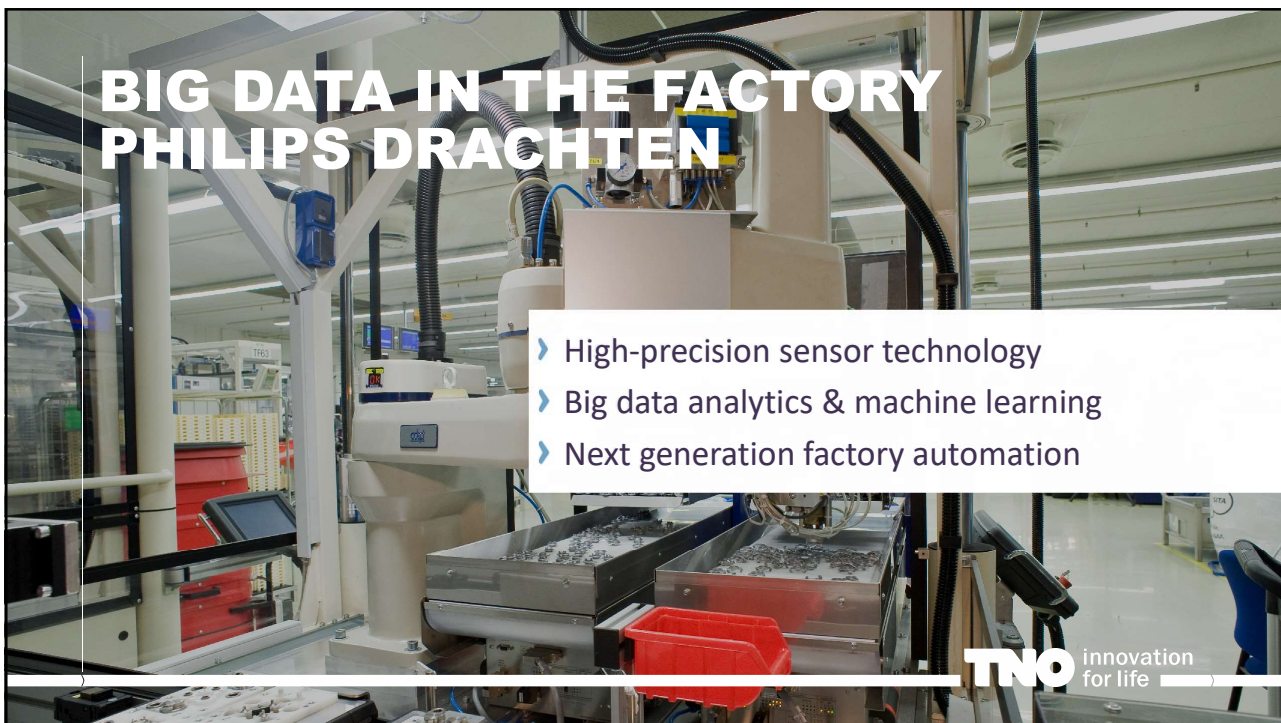**SMART INDUSTRY** DUTCH INDUSTRY FIT FOR THE FUTURE

BIG DATA IN THE FACTORY PHILIPS DRACHTEN

› High-precision sensor technology
› Big data analytics & machine learning
› Next generation factory automation

8. SMART CONNECTED SUPPLIER NETWORK

Fieldlab's goal is to achieve more efficient information exchange in the supply chain by means of standardization and interoperability. Starts with ERP software. Partners: Brainport Industries, KMWE, NTS Group, Eurotechniek, MKG, Isah, TNO. Location: Eindhoven.

5. THE GARDEN

Working together safely in the supply chain. Security in Smart Industry. The first project was EPLM (Extended Product Life Cycle Management). Partners: Thales, Demcon, Figo, Norma, Parthian, PM Group, USG, VIRO, VMI, Benchmark, True Information Solutions, Coblue, Vidinexus, NDIX, FME, Saxion, UT, TNO. Location: Hengelo (Dutch province of Overijssel).

24. FIELDLAB 5G

5G will turn the north Groningen area into the number one test ground for 5G mobile internet. Entrepreneurs and non-profit organizations work together with experts to test applications of 5G. Partners: EBG, KPN, Vodafone, Huawei, Ericsson, TNO, RUG, Hanzehogeschool University of Applied Science, SURF, Agentschap Telecom. Location: Groningen.

29. HIGH TECH SOFTWARE COMPETENCE CENTER

Consortium of 20+ high-tech software companies concerning virtual prototyping & design, model-based software and data analytics & services. Demonstrates how ground-breaking innovative software contributes to more efficient, more flexible and more high-quality development and production of hardware. #3x_faster_development #customizable #zero errors. Location: Eindhoven.
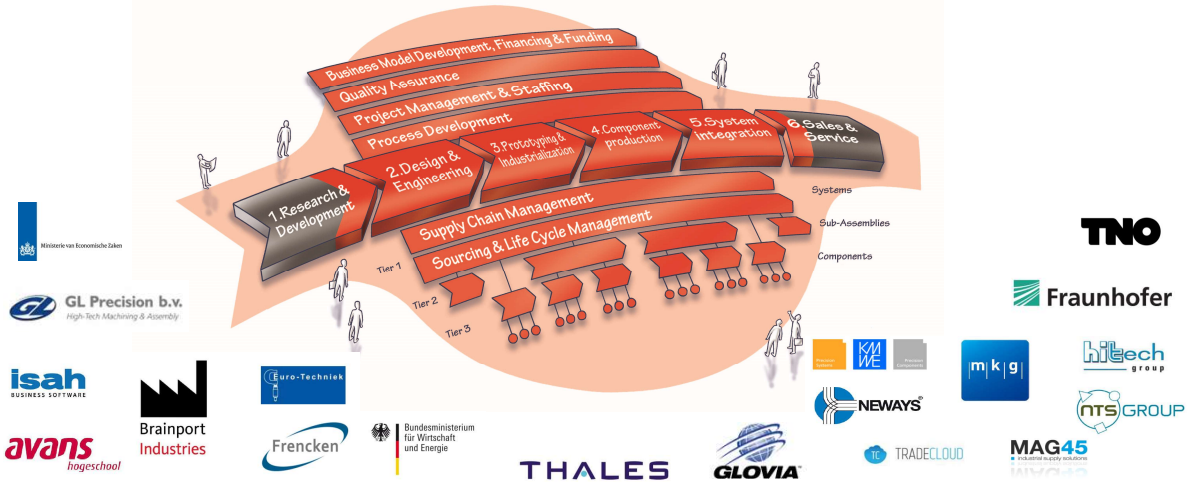
SMART INDUSTRY DUTCH INDUSTRY FIT FOR THE FUTURE

COLLABORATION FIELDLAB:
SMART CONNECTED SUPPLIER NETWORK

› Collaboration in the supply chain
› Interconnecting ERP and PLM systems

TNO innovation for life

Fieldlab Smart Connected Supplier Network (SCSN)

SMART INDUSTRY DUTCH INDUSTRY FIT FOR THE FUTURE

SMART INDUSTRY FIELDLABS 2015 - 2017

1. ULTRA PERSONALIZED PRODUCTS AND SERVICES
UPPS develops new methods to design and produce personalized products and services. Aimed at the entire process; from concept development and scanning, to engineering and data processing for production. Partners: CLICKNL, 4TU, universities of applied sciences, TNO, Philips, small and medium-sized businesses. Locations: Delft, Eindhoven, Enschede, Amsterdam.

2. REGION OF SMART FACTORIES
Is the factory of the future with a focus on faultless production and 'first-time-right' product development. The programme comprises 10 pilot projects, Centre of Expertise and scientific research. Partners: CIG Centraalstaal Groningen, Fokker Hoogeveen, Philips Drachten Groningen University, NOM and 40 companies, educational and knowledge institutions. Location: Northern Netherlands.

3. SMART DAIRY FARMING 3.0
Increasing sustainability (health and production), efficiency and profitability of dairy farming by collecting real-time data of dairy cows and sharing this in the supply chain. Partners: Friesland Campina, CRV and Agrifirm. Location: Amersfoort.

4. SMART BENDING FACTORY
State-of-the-art factory for laser-cutting and bending of steel, fully driven and controlled via internet. Goal: lowering 'total-cost-of-ownership' by 20% and accelerating the 'time-to-market' by a factor of 5. Partners: 247TailorSteel, Gunnebo, Innclose, Staja, Viscon, Jansen Metal Products, ROC Graafschap College, Anton Tijdink Educational Institution. Location: Varsseveld.

5. THE GARDEN
Working together safely in the supply chain. Security in Smart Industry. The first project was

13. RAMLAB
Develops knowledge of metal 3D printing and certifying large parts for the port/harbour- related sector. Partners: InnovationQuarter, Port of Rotterdam, RDM Makerspace, Valk Welding, Air Liquide, Autodesk, IBM, Lincoln Electric, Lemtech, M2i, Huisman, Heerema, Fokker, Koninklijke Marine (the Royal Netherlands Navy), Damen, Volkerrail, Allseas, MX3D, Bolier, Royal Roos, Promarin. Location: Rotterdam.

15. SMART WELDING FACTORY
Flexible and fully automated production using welding robots and without any programming time: 'first-time-right' and 'one-piece-flow'. Partners: LAC, NIL, Aebi Schmidt, Pan Oston, Stork Thermeq, Hoekman RVS, Exerion, Contour, Wive. Location: Enschede.

17. THE SUSTAINABILITY FACTORY
Smart Solutions maritime computerization/automation (robotics) and Smart Metrology. Stimulates the development and valorization of innovations in the maritime sector and facilitates 'Lifelong learning'. Partners: Valk Welding, Slob Shipyard, De Waal, Krohne Altometers, PRIVA, Verkerk, VIV, Opleidingsbedrijf Installatiewerk, VAF, Da Vinci College. Location: Dordrecht.

18. 3D MEDICAL
To achieve drastic improvements in personalized healthcare by means of SMART technology such as 3D Imaging and 3D printing. Collaboration with UMC Utrecht, Stichting ProtoSpace foundation and Utrecht University of Applied Sciences. Partners: MRIguidance, Zimmer Biomet, 3Devo, Ultimaker, Xilloc, Landre, Livit. Location: Utrecht.

19. COMPOSITES MAINTENANCE AND REPAIR
The goal is to fully computerize the maintenance and repair of composite parts, primarily airplanes. Partners: Stichting Development Center for Maintenance of Composites foundation (DCMC), Fokker, NLR, TU Delft, Airborne, the Dutch Air Force, REWIN, BOM, TIAT and Damen Shipyards. Location: Hoogerheide/Woensdrecht.

20. THERMOPLASTIC COMPOSITES NEDERLAND (TPC NL)
Centre for both fundamental and applied research for production using thermoplastic composites. Focus areas are tape laying, compression moulding, insert moulding, recycling and automation (robotics). Partners: TPRC and TPAC. Location: Enschede.

21. FIELDLAB CAMINO
The ambition is to achieve 100% predictable maintenance of infrastructure. Think of rail, electricity, water, gas, roads etc. The Camino steering committee consists of representatives of: Kennispark Twente, Oost NV, Strukton Rail / Sanderink Technology

smart industry

Partners: 247TailorSteel, Gunnebo, Innclose, Staja, Viscon, Jansen Metal Products, ROC Graafschap College, Anton Tijdink Educational Institution. Location: Varsseveld.

5. THE GARDEN
Working together safely in the supply chain. Security in Smart Industry. The first project was EPLM (Extended Product Life Cycle Management). Partners: Thales, Demcon, Figo, Norma, Parthian, PM Group, USG, VIRO, VMI, Benchmark, True Information Solutions, Coblue, Vidinexus, NDIX, FME, Saxion, UT, TNO. Location: Hengelo (Dutch province of Overijssel).

6. FRESHTEQ.NL
Technological innovations for greenhouse horticulture. Smart solutions for fully computerized production, cultivation and distribution of fresh fruit and vegetables. Creating Fresh Food chains for cities and densely populated regions all over the world. Partners: Demokwekerij Westland (Westland demo nursery), TU Delft, WUR, TNO, GHC. Location: Westland.

7. MULTI-MATERIAL 3D PRINTING
Aims to develop entirely new value chains, based on next-generation multi-material 3D print technologies and the accompanying data management systems. Partners: TNO, High Tech Systems Centre (TU Eindhoven), ECN, Admatec, Vertex-NextDent, Océ, Philips Lighting, DoMicro, PwC, ASML, XYCarb, BOM and LIOF. Location: Eindhoven

8. SMART CONNECTED SUPPLIER NETWORK
Fieldlab's goal is to achieve more efficient information exchange in the supply chain by means of standardization and interoperability. Starts with ERP software. Partners: Brainport Industries, KMWE, NTS Group, Eurotechniek, MKG, Isah, TNO. Location: Eindhoven.

Focus areas are tape laying, non-precision moulding, insert moulding, recycling and automation (robotics). Partners: TPRC and TPAC. Location: Enschede.

21. FIELDLAB CAMINO
The ambition is to achieve 100% predictable maintenance of infrastructure. Think of rail, electricity, water, gas, roads etc. The Camino steering committee consists of representatives of: Kennispark Twente, Oost NV, Strukton Rail / Sanderink Technology Center, Waterschap Vechtstromen water board and World Class Maintenance. Location: Enschede.

22. FIELDLAB SMASH
The ambition is to achieve 100% predictable maintenance. Condition Based Maintenance in shipbuilding. Collecting and analysing real-time information about the ship's condition in order to enable timely maintenance and prevent downtime. Partners: MCN/KIM, NMT, WCM, IQ, several asset owners and suppliers. Location: Rotterdam/ Drechtsteden and rest of the Netherlands.

23. SMART BASE
A testing ground for the development of a 'Smart Base' for the Dutch Ministry of Defence. In cooperation with innovative businesses, the Dutch Ministry of Defence is going to experiment in order to achieve protection, energy, water and 'support & services' solutions. Partners: Dutch Min. of Defence, LIOF, BOM, Oost NV, InnovationQuarter, NOM. Location: Amersfoort.

24. FIELDLAB 5G
5G will turn the north Groningen area into the number one test ground for 5G mobile internet. Entrepreneurs and non-profit organizations work together with experts to test applications of 5G. Partners: EBG, KPN, Vodafone, Huawei, Ericsson, TNO, RUG, Hanzehogeschool University of Applied Science, SURF, Agentschap Telecom. Location: Groningen.

25. INDUSTRIAL ROBOTICS
Develops certified robot programming and robot operation study programmes at intermediate and higher vocational education levels. Offers the possibility of developing, and experimenting with,

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possibility of developing, and experimenting with, new technology and applications. Partners: Altrex, Auping, AWL-Techniek, Deltion, Goma, IJssel Technologie, Kaak, Kinkelder, Landstede mbo, Moba, Nefit, Polynorm, VMI, Windesheim University of Applied Sciences, Wivé. Location Harderwijk.

9. FIELDLAB CAMPIONE
The goal of this first Fieldlab in the process industry is to make maintenance 100% predictable. Condition Based Maintenance: sensors monitor the status of installations in order to accurately predict when maintenance will be needed. The availability of factory installations is increased, whereas costs decrease. Partners: Consortium of about 20 companies, 10 knowledge institutions and 3 supporting organizations. Location: Gilze Rijen.

10. FLEXIBLE MANUFACTURING
The goal of this Fieldlab is to make production processes more flexible by using robotics etc. Simplifying the production of small series by shorter change-over times. Partners: Bronkhorst High Tech, Omron, Neways, De Cromvoirtse, Van Lierop, Fokker Landing Gear, Brainport Industries and TNO. Location: Eindhoven

11. DIGITAL FACTORY COMPOSITES
Facility for open cross-sector innovation. Computerized production of composites & demo centre for the computerized production of composites. Partners: Airborne Composites B.V., Siemens Nederland N.V., Kuka, TU Delft and Fontys University of Applied Sciences. Location: Ypenburg.

12. CENTRE FOR LIGHTWEIGHT STRUCTURES
The project concerns the computerized production of composite products and utilizes a pilot plant. Partners: NLR (Netherlands Aerospace Centre), Ampyx Power, Correlian, Fokker Landing Gear, Fontys University of Applied Sciences Engineering, Label/Breed, Kaptein Roodnat, Omron Europe, PAL-V, TNO, TU Delft, VABO Composites, Windesheim. Location: Marknesse.

Fieldlabs are practical environments where companies and knowledge institutions develop, test and implement Smart Industry solutions in a targeted manner. In addition, people also learn to apply these solutions in the Fieldlabs. They also reinforce connections with research, education and policy regarding a specific Smart Industry topic and they transfer knowledge to other entrepreneurs. 29 Fieldlabs with a regional, national or international focus started in the period 2015 - 2017.

For more information, go to www.smartindustry.nl/fieldlabs.

14. 3D MAKERS ZONE
Revolutionizing how things are made. Provides infrastructure, knowledge, experience, networks, ongoing projects and application knowledge in production processes for Internet of Things, 3D printing, robotization, wearables and Big Data. Partners: PWN, KLM, InHolland, Nova College, HvA, AkzoNobel, Deloitte, Rabobank, Hoogheemraadschap Hollands Noorderkwartier, Berenschot, the province of Noord-Holland. Location: Haarlem/Amsterdam.

16. CENTRE FOR PRECISION FARMING
Making data and measurement results available for (collective) use by agricultural companies, suppliers, processing industries and knowledge institutions. Offering demonstration and test facilities at the centre for precision farming and at external locations. Partners: ZLTO, Vd Borne, HAS Den Bosch, WUR, TU Eindhoven, BOM. Location: Reusel.

26. TECHNOLOGIES ADDED
The first Shared Smart Factory with a shared production location for Smart Manufacturing, incubators and service providers for this specific field. Added also offers 'in-house' facilities to Stenden University of Applied Sciences and other knowledge and educational institutions. Partners: Technologies Added, Sustainder, NOM, Stenden, RUG, Drente-college. Location: Emmen.

27. DUTCH OPTICS CENTRE
The objective of the DOC is to turn the Dutch opto-mechatronic industry into the global market leader by developing new value chains based on optical and opto-mechatronic technology platforms. Founders: TU Delft, TNO and 25 small and medium sized businesses and knowledge institutions. Location: Delft and Enschede.

28. ROBOHOUSE
Facility and innovation programme to further develop robotics in the Netherlands. The focus is on accelerating the adoption of 'state-of-the-art' robotics solutions in organizations. Partners: RoboValley, TU Delft, Festo, Exact, The Hague University of Applied Sciences, TNO, Innovation Quarter. Location: Delft.

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7 + 2 TRANSFORMATIONS (draft)

	Transformaties	Doelstelling transformatie	Voorbeelden
1	Servitization	Van productleverancier naar serviceprovider	Onderhoudsvrij produceren
2	Smart Products	Producten worden slim en zijn altijd digitaal verbonden.	Ultra personalized products Intelligentie in producten
3	Networked factories	Nederlandse bedrijven zijn in 2020 digitaal verbonden en wisselen cyber secure data uit	Data delen / cyber security Blockchain apps
4	Production systems	Van groot serie productie naar enkelstuks productie op maat	Enkelstuks productie n=1 Additive manufacturing
5	Manufacturing technologies	De nieuwste productietechnologie voor smart industry	High precision equipment Robotisering & mechatronics
6	Digital Factory	Het product, alle processen en de gehele fabriek intern digitaal gesimuleerd	Digital twin, zero defect Digitalisering van het product t.b.v. ontwerp tot aan afdanking.
7	Human centered production	De mens in de productie omgeving wordt maximaal ondersteund door nieuwe technologie	Inclusieve technologie Virtual and Augmented Reality
1	Eco Factory	Minimal resources and energy use	Recycling
2	Smart Industry, Skills & society	Industry en maatschappij benutten deze ontwikkeling maximaal over en weer	Smart respons, skills, wetgeving

SMART INDUSTRY DUTCH INDUSTRY FIT FOR THE FUTURE

Goals: Productivity increase with Digitalization and Sustainability

Productivity improvement = $\dfrac{\text{Results} \Rightarrow \text{Products \& Services}}{\text{Costs} \Rightarrow \text{Production \& Skills}}$

Results = innovative, new products with higher value

More customized products, with faster delivery time, for price of mass produced standard product from stock
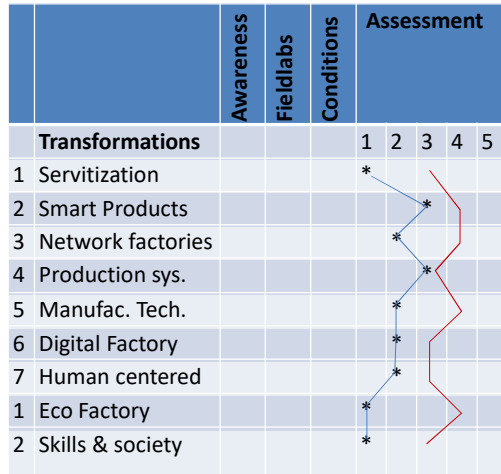
Costs = less (material) resources, less CO2 consumption

New constraint: cyber secure operations (if hacked, huge costs)

SMART INDUSTRY DUTCH INDUSTRY FIT FOR THE FUTURE

Applying Smart Industry in your Factory

		Awareness	Fieldlabs	Conditions	Assessment				
Transformations					1	2	3	4	5
1	Servitization				*				
2	Smart Products						*		
3	Network factories					*			
4	Production sys.						*		
5	Manufac. Tech.					*			
6	Digital Factory					*			
7	Human centered					*			
1	Eco Factory				*				
2	Skills & society				*				

—— Current level   —— Wanted level

Acquire awareness
 (internat.) exhibitions/literature
 visit factories & fieldlabs in your region
 investigate conditions (ICT, Skill, Knowlegde)

Assessment
 determine your goals, current and wanted status

Collect improvement/project ideas

Select those that contribute most to your goals

 And start implementing

SMART INDUSTRY DUTCH INDUSTRY FIT FOR THE FUTURE

Content

Introduction and main message

Technologies accelerates and we need to retrain everybody

But how is your business going to change?

   - product evolution and innovate your product

   - challenges on resource and energy (CO_2)

Implementing Smart Industry

Summary & Questions

SMART INDUSTRY DUTCH INDUSTRY FIT FOR THE FUTURE

Smart Industry - summary message

Smart Industry: acceleration of digitalisation of industry

Smart Industry, more then Industry 4.0, implies

- Servitization (Customization of capital goods & smart, personalized products)

- 4th generation, smaller, flexible, networked factory with jobs-back-to-town

- With IoT, Robotics, Blockchain, responsive/inclusive technologies

- And in which we need every one with tech skills to stay on board

Increase the digital skills of every one, not only business leaders, workers and students

So entrepreneurs can create new businesses and jobs and all in society can benefits

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